03M13A41

SWEEP GENERATOR VS-80

OPERATING AND INSTRUCTION MANUAL

Texscan

MP MASTER
MA34716

CERTIFICATION

Texscan Corporation certifies that this instrument has been thoroughly tested, inspected, and found to be in compliance with its published specifications.

ADDENDUM

VS-80-1

This instrument has been provided with a 1 KHz modulation feature. This feature is controlled by a rocker switch on the front panel and may be used to amplitude modulate the RF output.

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ADDENDUM

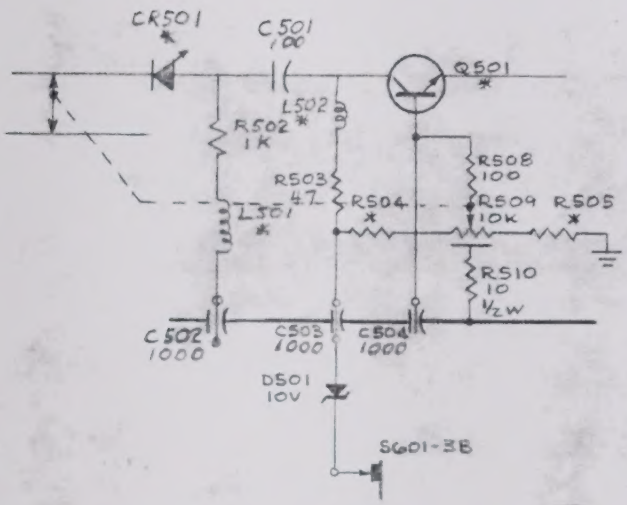
VS-80

July 19, 1967

The sweep oscillator was modified to include a variable resistor in the base bias network. This variable resistor R509 is ganged with the center frequency tuning shaft as shown below.

Parts Added:

Circuit Ref. No.	Texscan Stock No.	Description	Mfg., Mfg. Part No.
R509	048-095	Resistor, Variable, 10K ohm	Allen Bradley
R508	045-668	Resistor, Fixed, 100ohm, ±10%, ½W	Allen Bradley
R510	046-026	Resistor, Fixed, 10ohm, ±10%, ½W	Allen Bradley
D501	025-010	Zener Diode, 10V, VR10A	Sarke Tarzian VR10A



ADDENDUM

VS-80

June 5, 1967

Circuit reference numbers Q3, Q7, Q206 and Q207 changed from 2N3638A to 2N3644, Texscan Part Number 062-024

Circuit reference number R602 changed from Texscan part number 047-083 to Texscan part number 047-286, Resistor, fixed, 50 ohm, 1W, ± 1%.

Circuit reference number C604 changed from Texscan part number 012-002 to Texscan part number 012-001, capacitor, fixed, 1000pf, Allen Bradley FA5C GMV.

June 14, 1967

Circuit reference numbers CR1 and CR2 changed from Texscan part number 025-007, Diode, A13D2, to Texscan part number 025-044, Diode, 800V, E-3.

June 30, 1967

The high band center frequency specification has been changed to read 300 MHz to 1000 MHz.

The total swept frequency range has been changed to read 275 MHz to 1200 MHz on the high band.

August 1, 1967

Circuit reference number T1 changed from American Magnetics number 3441 to American Magnetics number 3531.

September 21, 1967

Circuit reference number Z551 changed from A204-059 to A204-214.

Circuit reference number L551 changed from Inductor Fixed, 1uh, Texscan Part Number 035-005 to Inductor, Fixed, 2.2uh, Texscan Part Number 035-002.

Circuit reference number Q501 changed from Factory Selected Value to Transistor, Fairchild, S-21970, Texscan Part Number 062-029.

Circuit reference number R504 changed from Factory selected value to Resistor, Fixed, 6.8K ohm, ½W, ± 10%, Texscan Part Number 045-745.

Circuit reference number R505 changed from Factory Selected Value to Resistor, Fixed, 3.9K ohm, ½W, ± 10%, Texscan Part Number 045-735.

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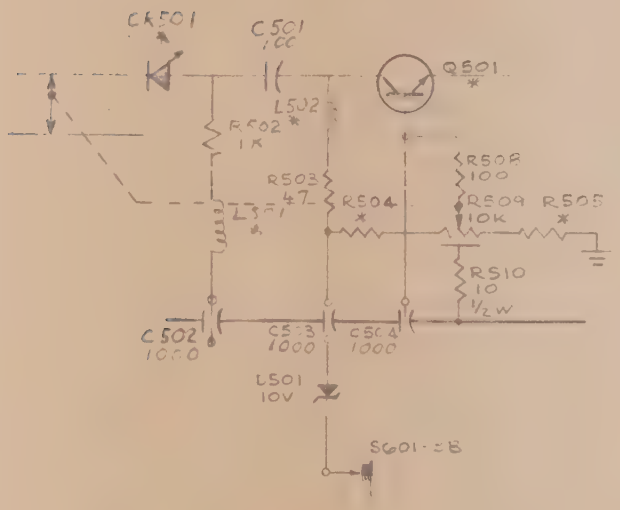

ADDENDUM

VS-80-A

This instrument has been provided with the attenuator option. A 10 db attenuator in 1 db steps has been added which increases the total attenuation capability to 90 db.

OPERATING AND INSTRUCTION MANUAL

MODEL VS-80

S/N 3065

SWEEP GENERATOR

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SECTION 1

SPECIFICATIONS

1.1	FREQUENCY RANGE	1 MHz to 1200 MHz in two overlapping bands. The unit can be centered at any frequency between 1 MHz and 1000 MHz and sweep up to 1200 MHz at maximum sweep.
1.2	SWEEP WIDTH	On the low band the sweep width is continuously variable from 50 kHz to 300 MHz while on the high band it can be varied to 40% at 1000 MHz. The unit is also provided with a CW output mode.
1.3	RESIDUAL FM	The residual FM on the low band is better than 20 kHz. On the high band the residual FM is better than 5 kHz at 300 MHz and 20 kHz at 1000 MHz.
1.4	RF OUTPUT	The RF output is at least 0.5v rms into a 50 ohm load.
1.5	FLATNESS	The flatness on the low and high bands is $\pm$ 0.25 db and $\pm$ 0.5 db respectively at maximum sweep width (tested with a wideband detector).
1.6	HARMONIC DISTORTION AND SPURIOUS	All frequency components due to harmonic distortion, and all spurious frequencies are typically 30 db down from the fundamental.
1.7	LINEARITY	The linearity on the high band is better than 2.5:1 at maximum sweep width as tested with 50 MHz marker spacing. It is better than 1.4:1 at 5% sweep width as tested with 10 MHz marker spacing. The linearity on the low band is better than 1.7:1 at maximum sweep width as tested with 50 MHz marker spacing and 1.4:1 at 10 MHz as tested with 1 MHz marker spacing. This is roughly equivalent to being within 5% of sweep width (in relation to the horizontal deflection voltage) on both bands and at any sweep width setting.
1.8	MARKERS	The unit has a birdy-by-pass marker system with provision for up to eight single frequency or harmonic markers. An external marker input is provided.
1.9	MONITOR	Both an internal monitor and facility to use an external monitor are provided.
1.10	SWEEP RATE	Four sweep rate modes are provided: (1) variable from 5 Hz to 60 Hz, (2) 50/60 Hz line rate, (3) manual sweep, and (4) external.

1.11	ATTENUATION	The unit has a 0 to 10 db vernier control of RF output and a turret attenuator which provides 0 to 70 db attenuation in 10 db steps.
1.12	SIZE	6-7/8" x 17" x 16"
1.13	CONSTRUCTION	Aluminum with G-10 printed circuit boards.
1.14	WEIGHT	Approximately 23 lbs.
1.15	POWER	Approximately 15 watts, 50/60 Hz, 115/230 volt power.

SECTION 2

GENERAL DESCRIPTION

2.1 GENERAL INFORMATION

The VS-80 sweep generator is a solid state instrument that provides wide frequency coverage, variable sweep rate, external marker capability, and complete control of the r-f output level. This unit has provisions for accepting up to eight single frequency or harmonic plug-in markers for frequency identification. A birdy-by-pass marker system is used providing accurate marker placement. The VS-80 has many additional features including manual sweep, and external leveling capability.

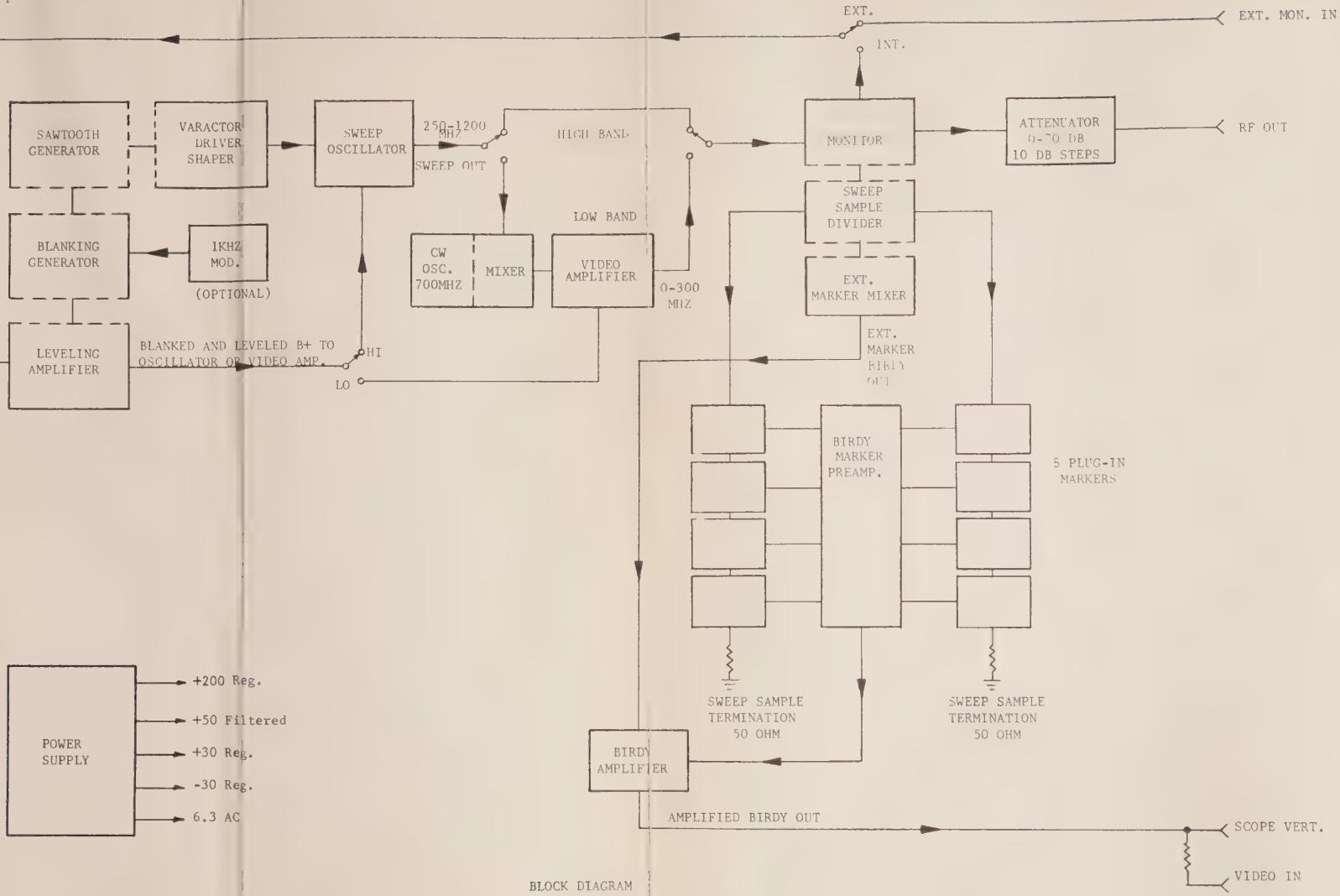
The transistors used are all silicon, and the low frequency circuits are assembled on high quality printed circuit boards for maximum reliability and serviceability.

The VS-80 covers the frequency range of 1 MHz to 1200 MHz in two bands. A block diagram of the sweep system is shown in figure 2-1. The lower frequency band of 1 to 300 MHz is derived by taking the low level heterodyne output of two oscillators and amplifying this output to 0.5v rms. Low level mixing is employed to maintain a low spurious output signal. The 275 to 1200 MHz band is provided as the output from a wide tuning range, fundamental, transistor oscillator. This output is also a low spurious r-f signal. An r-f switch is used to select bands and, as can be seen in figure 2-1, the r-f output is sampled and detected in the monitor block. This sample is amplified in the leveler circuitry, compared to a stable reference voltage, and the error voltage used to automatically alter the leveled B+ to compensate for r-f output level changes. On the low band, the leveling is done on the video amplifier while on the high band the r-f oscillator is leveled. This electronic servo system provides automatic leveling which maintains the sweep output flat to within $\pm$ 0.25 db on the low band and $\pm$ 0.5 db on the high band.

This same monitor system provides a sample of the r-f signal for use in the birdy-by-pass marker system. Markers are obtained by mixing the sweep sample with a c-w source and amplifying a narrow band of frequencies around the resultant zero beat. These markers can be conveniently added to the detected output of the unit being tested by using the adder provided in the unit.

The VS-80 is provided with a wide range of output attenuation capability--an r-f vernier attenuator with 10 db range, and a 10 db step attenuator providing up to 80 db of continuously variable output attenuation.

The variable sweep rate is possible because the unit is electronically swept with a varactor used as the voltage sensitive element of the sweep oscillator. The drive for the varactor is derived from a sawtooth generator and nonlinear shaping circuit. The sawtooth is distorted to compensate for the nonlinear voltage versus capacitance characteristic of the varactor, thereby providing a linear frequency change with time.



BLOCK DIAGRAM
FIGURE 2-1

2.2 INTRODUCTION

The block diagram of the VS-80, shown in figure 2-1, can be divided into seven major sections: (1) rate circuit, (2) linearity circuit, (3) leveler circuit, (4) sweep oscillator, c-w oscillator, and mixer, (5) video amplifier, (6) power supply, and (7) marker circuit. The following paragraphs present a description of the circuit details of each of these sections.

2.3 RATE CIRCUIT

The rate circuit schematic is shown in figure 6-1. This circuit provides the basic variable frequency square wave and triangular wave required for blanking and sweep drive. The circuit has four modes of operation corresponding to the four sweep rate modes provided with the VS-80. The four modes are achieved by changing the operating characteristics of the basic rate generator consisting of a Schmidt trigger and Miller integrator

Transistors Q101 and Q102 are incorporated in the Schmidt trigger, and Q103 and Q104 are used in the Miller integrator. This combination of a Schmidt trigger and Miller integrator provides square wave and triangular wave outputs with a fixed phase relationship. The square wave is present at the collector of Q102; the triangular wave, at the collector of Q104. The circuit provides these signals with constant amplitude over the frequency range of the rate generator.

The time constant of C102 and R120A is adjusted by varying R120A, the sweep rate vernier front panel control, thereby changing the sweep rate. At special request, C102 can be provided for different sweep rate ranges. In the standard VS-80, C102 and R120A have values which provide a rate variable from 5 to 60 Hz.

The square wave at the collector of Q102 is coupled through the switch assemblies, S103 and S101, to the leveling circuit and provides the basic blanking signal for that circuit. The triangular wave at Q104's collector is coupled to the linearity circuit. In the variable sweep rate mode this circuit is free running, and as pointed out previously, R120A, a front panel adjustment, can be varied to change the sweep rate.

The sweep rate selector switch, S103 (the five-pole sweep rate function switch), converts this basic rate generator to the other three modes of operation.

In the line rate position, a 60 Hz signal from the power transformer is coupled through C101 to the base of Q101. This signal locks the generator to the line frequency. The other poles of the switch convert the circuit time constants, etc., to insure the locking and provide the same amplitude signal as in the free-running mode.

In the manual sweep rate mode of operation, S103 bypasses the rate circuit and provides a d-c voltage at the rate generator output. R120B provides adjustment of this output voltage through the same amplitude swing normally available from the rate generator.

The last switch position, the external sweep rate position, also bypasses the rate circuit and allows the unit to be swept from an external source.

This circuit, in summary, supplies the time base for the blanking and sweep drive circuit.

2.4 LINEARITY CIRCUIT

The emitter follower, Q105, is the coupling stage between the rate circuit and the linearity circuit. It provides the drive voltage for the linear amplifier, Q106, and the nonlinear amplifier, Q107.

The diode break circuit, consisting of R137 through R146, CR104 through CR113, and R148 through R158, distorts the drive signal at the collector of Q107. This circuit is piece-wise linear. For example, for any assumed combination of forward and back biased diodes, the circuit has a linear characteristic. As the voltage at the collector increases, sequentially, each of the diodes conduct and the resultant waveform is distorted. This distorted drive voltage is coupled to the sweep width switch and potentiometer combination, S101 and R164.

The amplified linear drive signal at the collector of Q106 is also coupled to this potentiometer and switch combination. This linear drive voltage and the distorted drive voltage are added at this point in the proper proportions to maintain linearity as sweep width is reduced.

The output of S101 is the varactor drive voltage which is delivered to the sweep oscillator.

2.5 LEVELER

The leveler, also shown in figure 6-1, consists of a high gain d-c amplifier and switch combination which provides a blanked and leveled B+ to the sweep oscillator on the high band and the video amplifier on the low band. The square wave from the rate circuit is coupled through the d-c level setting stage, Q204, to the transistor switch, Q203. At the collector of Q203 is a switched d-c voltage of sufficient amplitude to turn Q201 off and on at the sweep rate. The switched signal at the emitter of Q201 is properly phased with the sweep drive so that it turns off the sweep oscillator on the high band and the video amplifier on the low band during the retrace time of the sweep oscillator. That is, the

distorted triangular wave from the linearity circuit sweeps the oscillator in one direction with its positive slope, and in the opposite direction with its negative slope. The blanked B+ is properly phased to turn off the output signal during the negative slope portion of the sweep drive.

This same circuit amplifies the monitor signal and provides the B+ in the proper phase to compensate for r-f output changes. The monitor signal is amplified with Q206, Q207, and Q202. This leveled signal is added to the blanking signal at the base of Q202. Q202 is an emitter follower whose output varies in opposite phase to the monitor signal change and is turned off during the sweep oscillator's retrace time.

The Q207 stage contains potentiometers for setting the maximum and minimum r-f vernier levels. Diodes are used to protect the base-emitter junctions of Q203 and Q201. Included in this circuit is a switch, S201, which bypasses the internal monitor and connects the leveler circuit to a front panel external monitor input connector. This allows the unit to be leveled at some remote location if the user provides a detected monitor signal from that leveling point.

2.6 SWEEP OSCILLATOR, CW OSCILLATOR, AND MIXER

The two oscillators, mixer, band switching, and video amplifier (discussed in the next section) are shown in figure 6-2. The sweep oscillator, a tuned line varactor swept oscillator using transistor, Q501, is tunable over the frequency range of 275 MHz to 1000 MHz and sweeps through the frequency range of 265 MHz to 1200 MHz. The sweep drive voltage for this oscillator is coupled to the varactor, CR501, which changes the electronic length of the tuned line, thereby changing the oscillator's output frequency.

The c-w oscillator is also a tuned line oscillator using transistors Q551 and Q552. This oscillator has a fixed output frequency of 700 MHz.

The mixer consists of CR551, CR552, CR553, and CR554 in a bridge circuit with a low-pass filtered output.

On the high band, the fundamental output of the sweep oscillator is coupled through the switch, S601, to the monitor system. In this switch position S601 delivers the blanked and leveled B+ to the sweep oscillator. The c-w oscillator (as well as the video amplifier) is turned off while switched to the high band.

On the low band, the output from the sweep oscillator is coupled through S601 to the mixer; the c-w oscillator is turned on; a fixed B+ is connected to the sweep oscillator; and leveled B+ and a fixed B+ signal are delivered to the video amplifier.

The swept r.f. is coupled through C554 and R558 to the mixer system while the c-w signal is coupled from a loop terminated with R554 and R555. These two signals are mixed, and the lower sideband output is coupled through C555, C556, R556, and the low-pass filter Z551. The mixer system is operated at low signal levels within the diode square law region, to produce a low spurious output signal for the video amplifier.

The low band system is designed so that the 0 to 300 MHz range is covered with the sweep oscillator operating in the frequency range of 700 to 1000 MHz. In order to obtain this output, the center frequency dial must be tuned to this frequency range; consequently, in this range the center frequency dial has two calibrations. The output of the video amplifier is coupled to the monitor system through S601.

The r-f output from S601 is sampled in the monitor and detected with CR601. This detected signal is filtered by C601 and delivered to the leveler circuit as the monitor signal. This leveling system maintains the r-f output constant at the monitor point which, consequently, becomes a constant voltage, zero impedance point. R602, therefore, creates the source impedance for the sweep generator. The r.f. is coupled through Z603, a 10 db step attenuator, to the front panel.

Two samples of the r.f. for use in the marker circuitry are coupled from the monitor point through R603, R604, R605, and R606. These samples of the output signal are necessary for production of markers in the birdy-by-pass system.

Also included in the monitor is an external marker mixer. If an r-f signal is injected into the external marker input, it mixes with the sweep sample of CR602 to produce a beatnote or birdy. This birdy is filtered with R609, C603, and C604, and delivered to the marker amplifier circuit.

2.7 VIDEO AMPLIFIER

The video amplifier schematic is also shown in figure 6-2. The video amplifier amplifies the output from the low-pass filter described above.

This video amplifier has a relatively flat frequency response from 1 MHz to 300 MHz. It consists of three gain stages, each stage including a common emitter amplifier transistor and an emitter follower transistor. The three stages are essentially identical. Within each stage feedback is employed to stabilize gain. For example, in the input stage, C406, R406, and R407 provide local feedback. Neutralization is also included in each couplet. For example, C405 in the input adjusts the phase of the feedback in the emitter of Q401.

The output of the video amplifier at the emitter of Q406 is coupled through the monitor and rotary attenuator to the front panel.

The B+ voltage to the first two stages, which varies with r-f output level, is properly phased to increase B+ voltage when the detected r-f output decreases. Both this B+ and the 50 volt B+ to the last stage are turned off when the unit is switched to the high band.

2.8 POWER SUPPLY

The d-c power supply for this unit is shown in figure 6-3. This circuit provides--regulated +7v, +30v, +200v (serial numbered units below 1268 use a +190v supply), and -30v--and an unregulated +50v. The input transformer, T1, is designed so that the unit can be wired for either 115v or 230v input voltages. The units are normally shipped wired for 115v.

All the power supply voltages are derived from three full wave rectifiers. One full wave rectifier, consisting of CR1 and CR2, is filtered with C1A, C1B, and R15, and coupled through the pass transistor, Q8. This is the +200v regulated output. The voltage across the pass transistor is electronically varied to compensate for line voltage and load impedance changes. Any change in output voltage is sensed by the voltage divider consisting of R18, R19, and R20, compared to the reference Zener, D6, then differentially amplified in Q10 and the emitter follower, Q9; thereby changing the current through the base of the pass transistor, Q8, in the proper phase to compensate for this output voltage change. This well-regulated d-c voltage typically has an output ripple of 3 mv and maintains its regulation through a 10% line voltage change.

The +30v supply is fed from the full wave rectifier consisting of CR5 and CR6. This circuit is similar to the circuit used in the +200v supply except the resistor values and Zener voltages differ; and an additional transistor stage, Q3, is added for preregulation. This supply typically has a ripple, at the output, of 6 mv.

The -30v supply is fed from the full wave rectifier consisting of CR3 and CR4 and fed through pass transistor, Q5. This regulator circuit is essentially the dual of the +200v supply with the transistor hookup varied to achieve a negative output voltage. Some additional filtering of Zener noise through C8 was added to this circuit. This regulated -30v typically has a ripple of 4 mv.

The +50v output is taken from the input of the +30v regulator and filtered with R1 and C1D.

2.9 MARKER CIRCUITRY

The unit is supplied with a birdy-by-pass marker system, figure 6-4, which has an external marker capability plus provision for eight plug-in single frequency (SM) or harmonic (HM) markers. In the marker system a sample of the swept r-f signal is mixed with the fundamental or a harmonic of the plug-in markers to produce beatnotes or birdies.

These beatnotes or birdies are then amplified, shaped, and superimposed upon the demodulated video signal and applied to the vertical channel of the oscilloscope. When an external c-w source is being used as a marker, the signal from the monitor is fed to the external marker amplifier, Q306, which is a high gain common emitter amplifier.

R331 is a front panel, external marker size control which allows the external marker system to accept a wide variation in signal source amplitudes.

The plug-in marker system is seen to consist of eight plug-in receptacles. Each plug-in receptacle has its own internal size adjustment. The markers produced in each plug-in can be independently controlled in amplitude with potentiometers R305, R306, R311, R312, R317, R318, R324, and R325. This allows each marker to be adjusted to a different amplitude and gives quick and easy identification of the various markers on the oscilloscope display.

There are four amplifier stages built on the plug-in marker printed circuit board. Each amplifier stage is being fed from two plug-in marker receptacles. The outputs of all four amplifier stages are fed through a common emitter amplifier, Q305. This plug-in marker signal and the external marker signal from Q306 are coupled to a common birdy amplifier stage which includes the marker shaper circuit consisting of C307, C308, C309, C310, C311, L301, R334, and R335. This shaped marker is further amplified in Q307.

After amplification, the markers are applied to the marker size potentiometer, R339, which is a front panel adjustment, and become available at the oscilloscope vertical output connector on the front panel.

The connection of the sweep sample cables to the plug-in marker sockets is accomplished as shown in figure 2-2.

FIGURE 2-2
PLUG-IN MARKER HOOKUP (One of two rows shown)

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

The VS-80 is a versatile, wide range sweep generator which incorporates the latest sweep techniques. It can be employed as a c-w source as well as a sweep generator. Most of its operating features can be easily understood from a description of the front panel controls. This unit is supplied for operation from a 115 volt, 50/60 Hz power source. The unit can be provided for 230 volt operation or can be converted by the customer. For conversion from 115 volt to 230 volt operation, consult figure 3-1.

3.2 DESCRIPTION OF FRONT PANEL CONTROLS

A drawing of the front panel of the VS-80 is shown in figure 3-2. An identification of each control and its function is as follows:

3.2.1 Center Frequency Dial

Indicates the frequency of the oscillator in the c-w modes and at minimum sweep width in the sweep modes.

3.2.2 Power Switch

Switches on the line voltage to the unit.

3.2.3 RF Level Set Potentiometers

Two potentiometers are provided to set the maximum and minimum output power levels which can be obtained by varying the r-f vernier control. These potentiometers are set at the factory for proper operation with the internal monitor system. They are provided as front panel controls so that if an external monitor is employed, these levels can be reset.

3.2.4 Ext. Marker Size Control

Provides adjustment of the amplitude of the external marker, if used.

3.2.5 Fixed Marker Size and Shaper

This dual control varies the size of the birdy markers provided from plug-in SM or HM markers. The shaper can be used to vary the bandpass of the birdy amplifier and, subsequently, narrow or widen the birdy marker width.

3.2.6 Band Selection Switch

This switch selects the low or high frequency band of the unit. The low band covers 1 MHz to 300 MHz, while the high band covers 275 MHz to 1200 MHz.

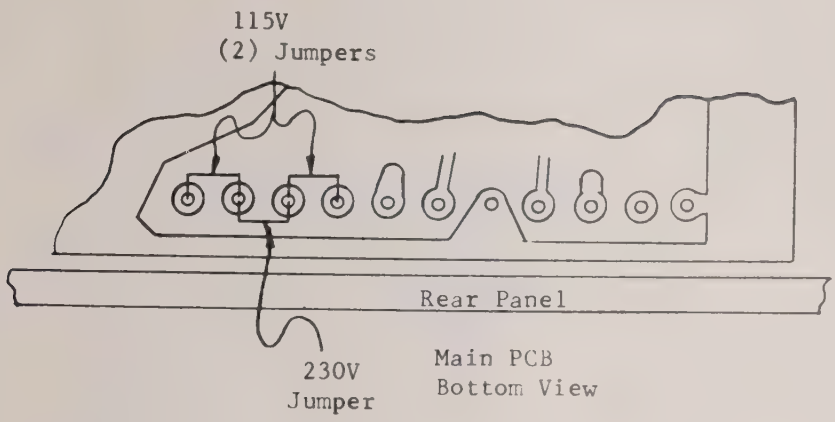


FIGURE 3-1

115V, 230V Hookup

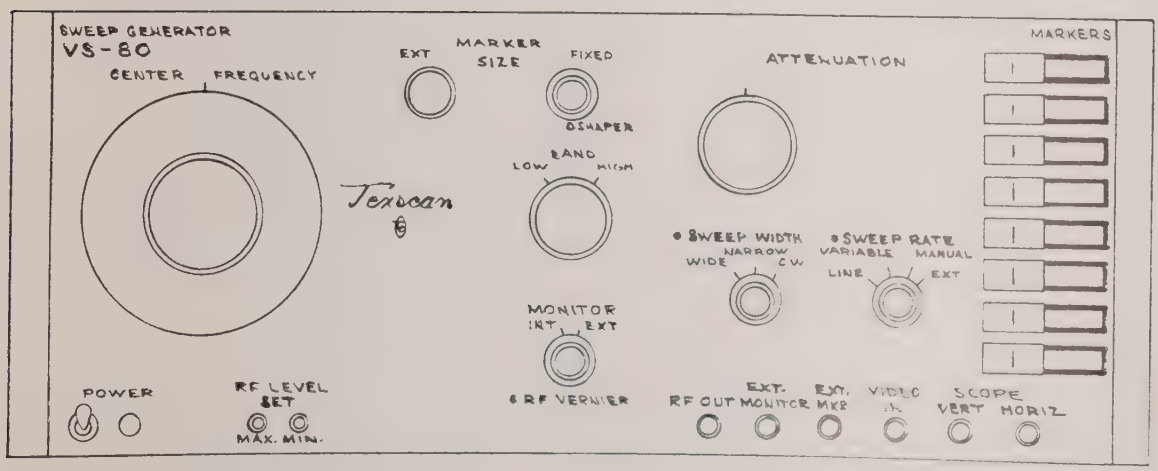


FIGURE 3-2

FRONT PANEL CONTROLS

3.2.7 RF Vernier and Monitor Switch (Monitor switch is not provided on serial numbers below 1095)

The r-f vernier provides continuously variable adjustment of the r-f output level over a 10 db range.

3.2.8 Attenuation

The turret attenuator can be used to control the amplitude of the r-f output by 70 db in 10 db increments.

3.2.9 Sweep Width Control

This potentiometer and switch combination is used to vary the sweep width of the output and to select the c-w mode of operation.

3.2.10 Sweep Rate Control

This potentiometer and switch combination provides control of the rate at which the r-f output is swept. Four modes are provided: (1) Line--50/60 Hz sweep rate, (2) Variable--5 to 60 Hz continuously variable, (3) Manual--center knob can be used to manually sweep the unit, (4) External--external source may be employed to sweep the r-f oscillator.

3.2.11 Marker Switches

These switches are used to turn on or off any plug-in marker employed.

3.2.12 RF Out Connector

Connector for swept or c-w output.

3.2.13 Ext. Marker Connector

This connector allows an external signal source to be inserted to provide a marker on the video output.

3.2.14 Video In Connector

The detected r.f. from the device under test is inserted here to superimpose birdy markers on the detected signal.

3.2.15 Scope Vertical

The detected r-f signal with markers superimposed is available at this connector for connection to the oscilloscope vertical channel.

3.2.16 Scope Horizontal

The oscilloscope horizontal drive signal is available at this connector.

3.2.17 Ext. Monitor Connection

The monitor signal from an external monitor, if used, is inserted here.

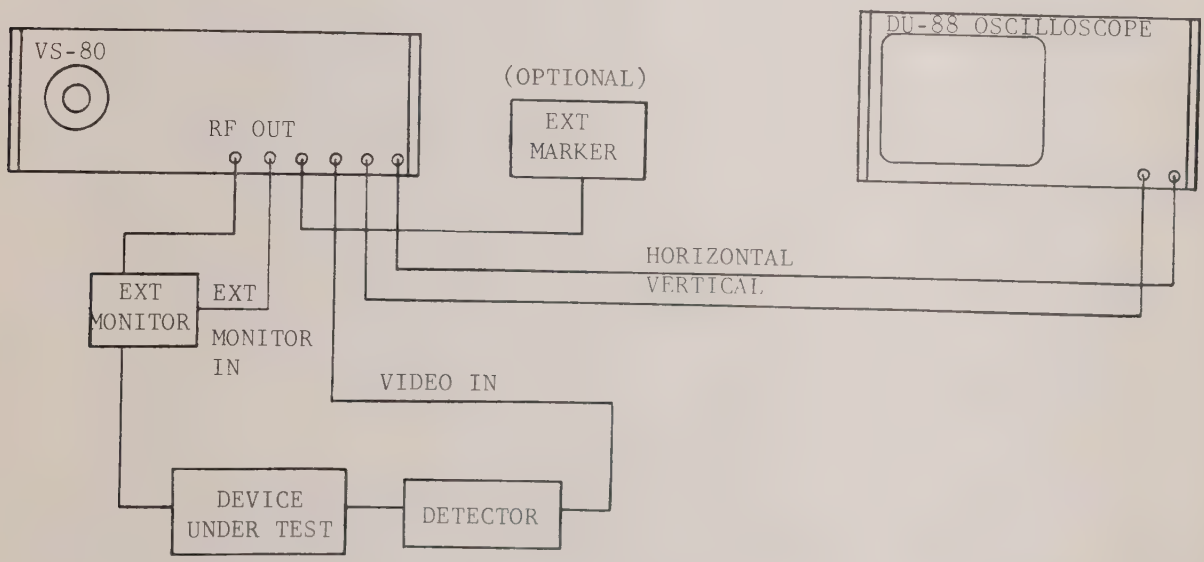
3.3 DESCRIPTION OF REAR PANEL CONTROLS

3.3.1 External Sweep Drive Connection

An external sweep drive signal can be inserted here to sweep the unit at a rate not provided internally.

3.4 TYPICAL TEST SETUP

Make connection to the oscilloscope, device under test, detector, and sweep generator as shown in figure 3-3.



TYPICAL TEST SETUP

Figure 3-3

This is the setup for measurement of bandpass characteristics and is the most widely used application for sweep generators.

SECTION 4

ADJUSTMENT PROCEDURE

4.1 INTRODUCTION

The adjustments and test of this instrument can be accomplished with the following auxiliary test equipment--an oscilloscope (such as HP-130), a VTVM, and a multimeter. It is suggested that the reader familiarize himself with the unit's circuit operation by reading section 2 before attempting alignment of the instrument. Test of the unit for spurious level and harmonic distortion requires a high frequency oscilloscope and a sampling scope.

Section 4.2 gives a discussion of the internal controls which require identification during alignment of the unit. Subsequent sections describe in detail the alignment procedure for each circuit. All internal controls are properly adjusted at the factory and only minor adjustments should be required in the field due to aging or changing of components.

4.2 EXPLANATION OF INTERNAL CONTROLS

Refer to figure 4-1 to identify the location of each of the following controls.

4.2.1 R6, +30 Volt Adjust

Adjusts the output voltage of the +30 volt power supply.

4.2.2 R12, -30 Volt Adjust

Adjusts the output voltage of the -30 volt power supply.

4.2.3 R19, +200 Volt Adjust

Adjusts the output voltage of the +200 volt power supply.

4.2.4 R101, Upper Trigger Point Adjust

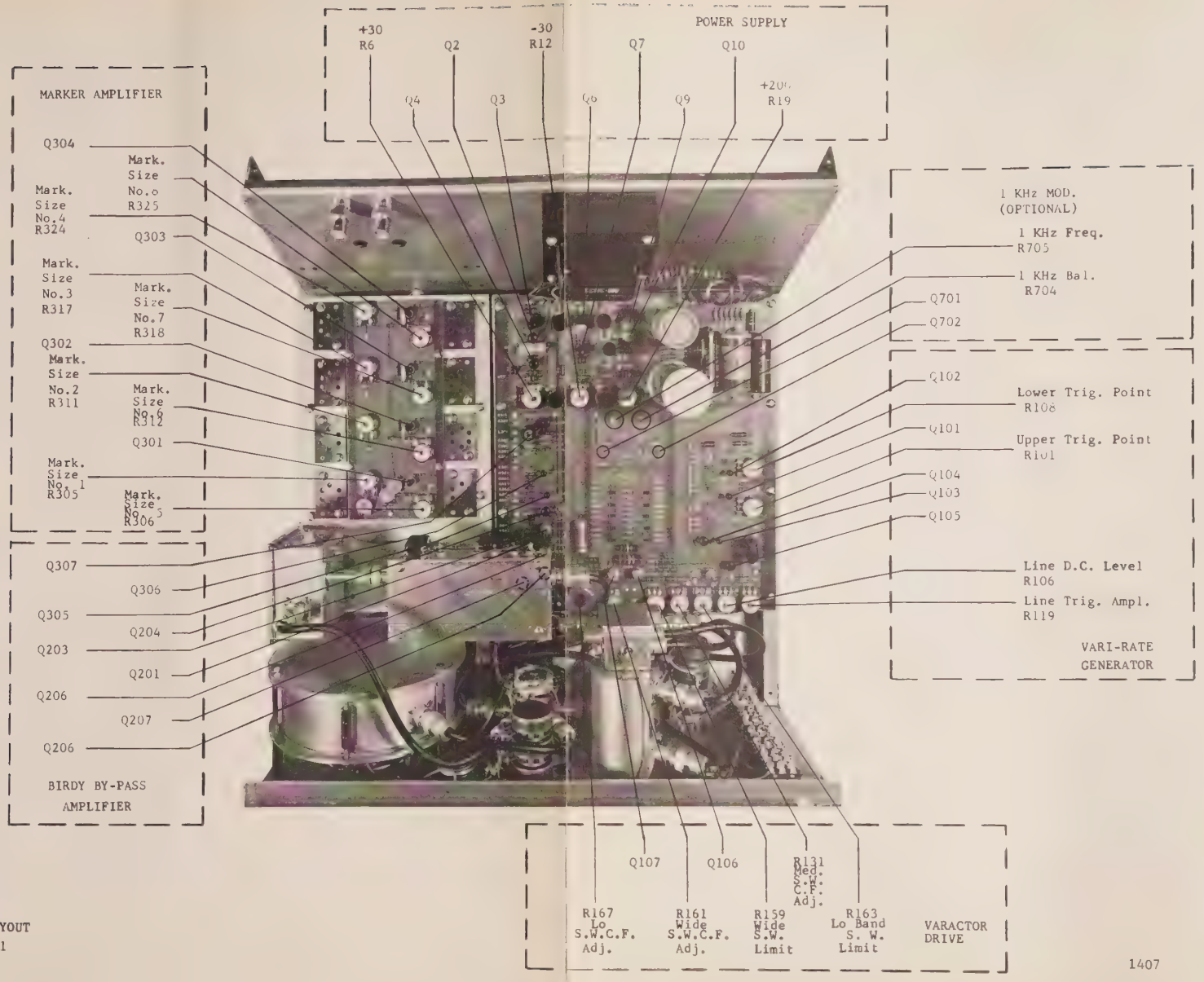
Adjusts the upper trigger point for the Schmidt trigger in the rate generator.

4.2.5 R106, Line DC Level Adjust

Adjusts the d-c level of the rate generator output voltage in the line rate mode of operation so that it is equal to the d-c level in the variable rate mode.

4.2.6 R108, Lower Trigger Point Adjust

Adjusts the lower trigger point for the Schmidt trigger in the rate generator.



CHASSIS LAYOUT
FIGURE 4-1

4.2.7 R119, Line Trigger Amplitude Adjust

Adjusts the amplitude of the rate generator output voltage in the line rate mode of operation so that it is equal to the amplitude in the variable rate mode.

4.2.8 R161, High Sweep Width Center Frequency

Adjusts the d-c level of the linearity drive voltage and is used to adjust center frequency at wide sweep width.

4.2.9 R131, Medium Sweep Width Center Frequency Adjust

Adjusts the d-c level of the linearity drive voltage and is used to adjust center frequency at medium sweep width.

4.2.10 R163, Sweep Width Limit Adjust

Adjusts the varactor drive size on the low band only, thereby adjusting the maximum sweep width.

4.2.11 R159, Wide Sweep Width Limit Adjust

Adjusts the linearity drive voltage and is used to set the maximum sweep width limit.

4.2.12 R167, Low Sweep Width Center Frequency Adjust

Adjusts the center frequency at narrow sweep widths.

4.2.13 R305,R306,R311,R312,R317,R318,R324,R325--Marker Size Adjustments

These controls provide individual adjustment of the marker size available from plug-in marker receptacles one through eight.

4.2.14 C553, CW Oscillator Frequency Adjust

Adjusts the oscillator frequency of the c-w oscillator.

4.3 POWER SUPPLY

4.3.1

With the unit plugged in and the power switch on, monitor the -30v point with an accurate voltmeter and a high gain a-c coupled oscilloscope at the emitter of Q7.

4.3.2

Adjust R12, the -30 volt adjust potentiometer, for a -30 volt level. The a-c ripple, as viewed on the scope, should be about 4 mv.

4.3.3

Connect the meter and scope to the emitter of Q1 and adjust R6 for a +30 volt level. The ripple should be about 6 mv.

4.3.4

Connect the meter and scope to the emitter of Q8 and adjust R19 for a +200 volt level. The ripple should be about 6 mv.

4.4 RATE GENERATOR

4.4.1

To align the rate generator perform the following operations:

4.4.1.1

Connect a direct coupled oscilloscope to the emitter of Q105.

4.4.1.2

Set the sweep rate function switch to variable.

4.4.1.3

Turn the power switch on.

4.4.2

Set the oscilloscope to internal sweep, 20msec per 10 divisions. Note the limits of the voltage at emitter Q105. This voltage should vary from +1 volt to +22 volts, $\pm$ 0.25 volt. If it doesn't, adjust R108 (lower trigger point adjust) and R101 (upper trigger point adjust) for this voltage swing. If it doesn't adjust, refer to section 5 for trouble shooting instructions.

4.4.3

Rotate R120 throughout its range and, using the time base on the oscilloscope, verify that the frequency of the triangular wave is adjustable from below 5 Hz to above 60 Hz. As R120 is varied, the amplitude of the waveform should remain nearly constant.

4.4.4

Switch the sweep rate function switch to line position and adjust R106 and R119 until the triangular wave amplitude and d-c level are the same as noted in 4.4.2.

4.4.5

Set the sweep rate function switch to manual. Verify that as R120 is varied the amplitude of the d-c voltage at the emitter of Q105 varies between +1 and +22 volts. If it does not, refer to section 5 for trouble shooting procedures.

4.4.6

Disconnect the scope probe from Q105 and connect it to the emitter of Q204. The presence of a 0 to 20 volt square wave indicates that the blanking circuit is operating.

4.4.7

If any of the steps cannot be completed, refer to section 5 for trouble shooting procedures.

4.5 LINEARITY CIRCUIT

4.5.1

The unit is provided with no internal controls to adjust linearity, but the sweep width of this unit can be adjusted by performing the following operation.

4.5.1.1

Connect the unit to the oscilloscope as indicated in the typical test setup, figure 3-3, but omit the device under test.

4.5.1.2

The best method to use when adjusting sweep width requires a 50 MHz harmonic marker (HM-50). If another harmonic marker is available, it can be employed with note taken of the changes required in the following procedure.

4.5.1.3

If a 50 MHz harmonic marker is used, switch to the high band and set the center frequency adjustment knob to 1000 MHz. Adjust the oscilloscope horizontal gain for 10 cm of horizontal deflection.

4.5.1.4

Advance the sweep width potentiometer front panel control to full sweep width. Adjust R159 and R161 for centering of the 1000 MHz marker and 400 MHz sweep width. You will note that there will be approximately 15 MHz more sweep width above 1000 MHz than below. This is normal.

4.5.1.5

Slowly decrease sweep width and adjust R131 to maintain centering of the 1000 MHz marker. With it properly set at 50 MHz sweep width, go to the next step.

4.5.1.6

Rotate sweep width to near its minimum value and recenter the 1000 MHz marker with R167.

4.5.1.7

Repeat steps 4.5.1.3 through 4.5.1.6 to more finely adjust the settings.

4.6 RF LEVEL ADJUSTMENT

4.6.1

With the same setup as used in section 4.5, set the r-f vernier for maximum output.

4.6.2

Being certain that the monitor switch is set for internal monitoring, adjust the maximum level potentiometer for 0.5v detected output level as noted from the oscilloscope calibrated display.

4.6.3

Switch in 10 db of attenuation and note the vertical deflection on the oscilloscope.

4.6.4

Rotate the r-f vernier for minimum output, remove the 10 db of attenuation, and adjust the minimum level potentiometer for the same level of detected output as noted in 4.6.3.

4.7 MARKER SIZE

4.7.1

Individual marker size controls are provided, as well as the front panel control, so that if a complicated set of markers are employed, their relative sizes can be set for easy identification.

4.7.2

For example, if 50 MHz, 10 MHz, and 1 MHz harmonic markers are all used with the front panel fixed marker size control about 3/4 clockwise, adjust the internal control for the HM-50 for 0.2 volt birdies, the HM-10 for 0.1 volt, and the HM-1 for 0.05 volt producing an easily identified display.

4.7.3

The fixed marker size control must be set for large marker size before adjusting the external marker size control. When testing the external marker function, be sure to have the fixed marker size control set for maximum size.

4.8 SWEEP OSCILLATOR, MIXER, AND VIDEO AMPLIFIER

These circuits are such that adjustment of internal controls to realign is impractical. They are designed to require no adjustment in the field. These circuits should only be investigated when trouble shooting procedures have isolated a problem to that area.

4.9 SPURIOUS CONTENT AND HARMONIC DISTORTION

4.9.1

The simplest way to determine the distortion and harmonic content level is with a sampling oscilloscope and a high frequency oscilloscope (i.e. a Tektronix 547 and 1A1 and 1S1 heads).

4.9.2

Set the VS-80 for c-w operation near 1 MHz.

4.9.3

Connect the r-f output to a high frequency oscilloscope (i.e. Tektronix 547 with 1A1 head) and adjust the oscilloscope for a 6 cm vertical display.

4.9.4

Adjust the time base of the oscilloscope for one or two cycles of r.f. and note the deviation from a sinewave.

4.9.5

Vary the center frequency of the unit between 1 and 50 MHz and note the distortion.

4.9.6

If the unit meets its shipping specification, the distortion as measured with the following formula, will be less than 5%.

4.9.7

Given the presentation shown in figure 4-3, a measure of distortion can be obtained by calculating $\frac{A-B}{A+B}$ = % Distortion

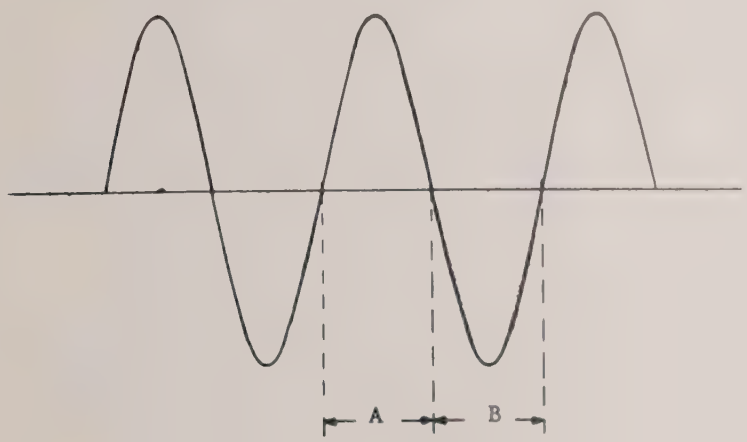


Figure 4-3

LOW FREQUENCY DISTORTION DISPLAY

4.9.8

Adjust the high frequency oscilloscope time base for at least 10 cycles of r.f. and note if any lower frequency modulation is present when the unit is tuned from 1 MHz to 50 MHz.

4.9.9

A typical presentation is shown in figure 4-4. The spurious is easily calculated from the formula 20 log $10 \frac{A}{a}$ = Spurious Level in DB

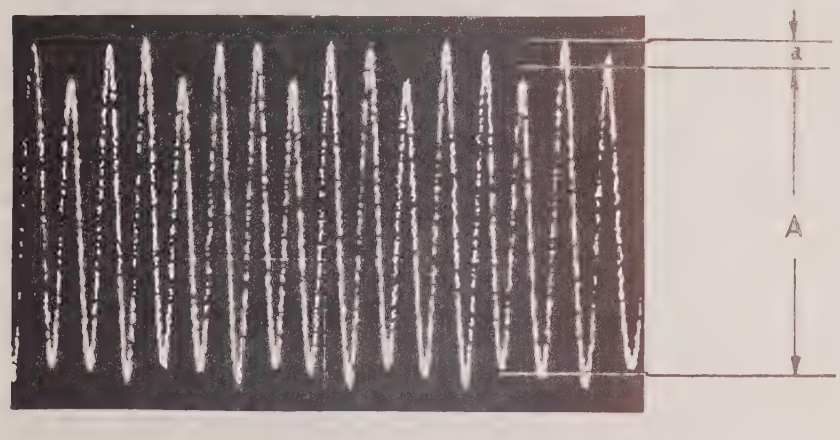


Figure 4-4
SPURIOUS LEVEL TEST DISPLAY

4.9.10

If the unit is operating normally, this level is typically more than 30 db down.

4.9.11

Substitute a sampling oscilloscope for the high frequency oscilloscope (i.e. the 1S1 head for the 1A1 head) and repeat steps 4.9.3 through 4.9.10 while varying the VS-80 between 50 MHz and 1000 MHz.

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

As in trouble shooting any electronic equipment, the best approach is to systemically attempt to isolate the problem to a particular circuit, and then a component, by the process of elimination. Before attempting to find any failure, it is suggested that the trouble shooting technician or engineer become familiar with the equipment by reading sections 2 and 3 of this manual. The following section, section 5.2, presents a trouble shooting chart which lists some of the more common failures. This chart should assist in finding or localizing the defective part. A VTVM and an oscilloscope should be sufficient tools in testing the unit.

5.2 TROUBLE SHOOTING CHART

SYMPTOM	CHECK
5.2.1	
Power switch on, but the pilot light does not come on.	F1
5.2.2	
F1 blows when unit is turned on.	Shorts across power supply outputs. Power supply transistors. Power supply rectifiers. T1.
5.2.3	
No RF output on high or low band.	Power supply voltages. Leveler voltage. Oscillator transistor, Q501. CR503. R602. RF cables. RF switch.
5.2.4	
RF output on high band, but no RF output on low band.	CW oscillator transistors, Q551 and Q552. CR551, CR552, CR553, and CR554. Video amplifier transistors. +50v supply.
5.2.5	
Insufficient RF output--high band.	Maximum level set potentiometer, R456. +30v supply. -30v supply. Leveler transistors. Sweep oscillator output.
Insufficient RF output--low band.	Video amplifier transistors, CR551, CR552, CR553, CR554.

SYMPTOM	CHECK
5.2.6	
No horizontal output.	Q101, Q102, Q103, Q104, Q105.
5.2.7	
No birdy markers.	L301 shorted. Q306, Q307, and Q305.
5.2.8	
Individual marker plug-in socket produces no birdies.	Individual amplifier transistors (Q301, Q302, Q303, or Q304).
5.2.9	
No external marker capability.	CR602. Q306.
5.2.10	
Flatness not meeting specification.	CR601. Level transistors (Q201, Q202, Q203, Q206, and Q207).
5.2.11	
+30v not present or has excessive ripple.	CR5, CR6, C1C, and C6. Q1, Q2, Q3, and Q4.
5.2.12	
-30v not present or has excessive ripple.	CR3, CR4, C7, C11. Q5, Q6, Q7.
5.2.13	
+200v not present or has excessive ripple.	CR1, CR2, C1A, C1B, C14. Q8, Q9, Q10.
5.2.14	
Power supply voltages don't adjust properly.	D2, D3, D4, D5, and D6. Transistors in power supply.
5.2.15	
Insufficient sweep width.	+200v supply. Q105, Q106, Q107.
5.2.16	
No blanking.	Q203 and Q204.

SECTION 6

DOCUMENTATION

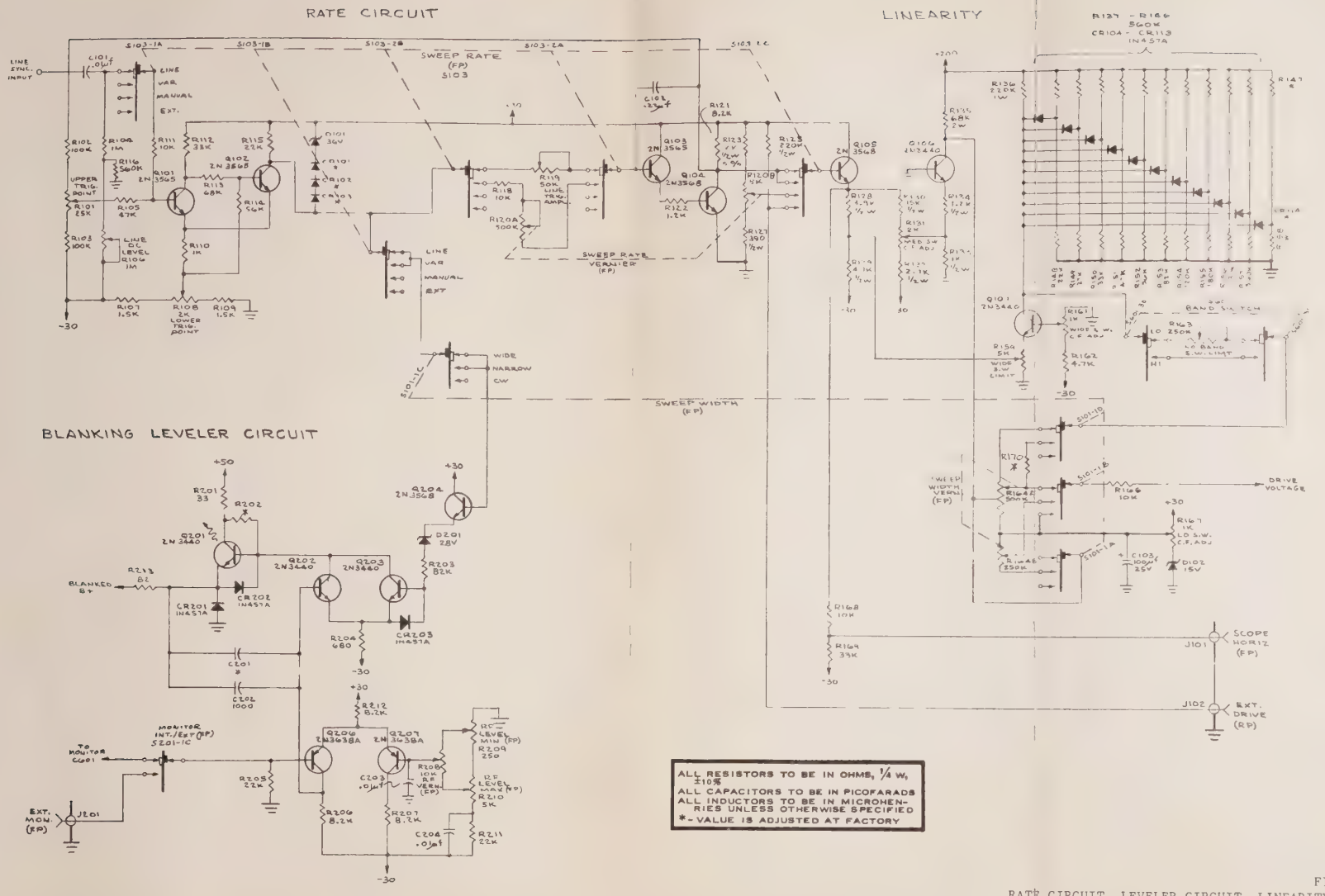


FIGURE 6-1
RATE CIRCUIT, LEVELER CIRCUIT, LINEARITY CIRCUIT
6-1

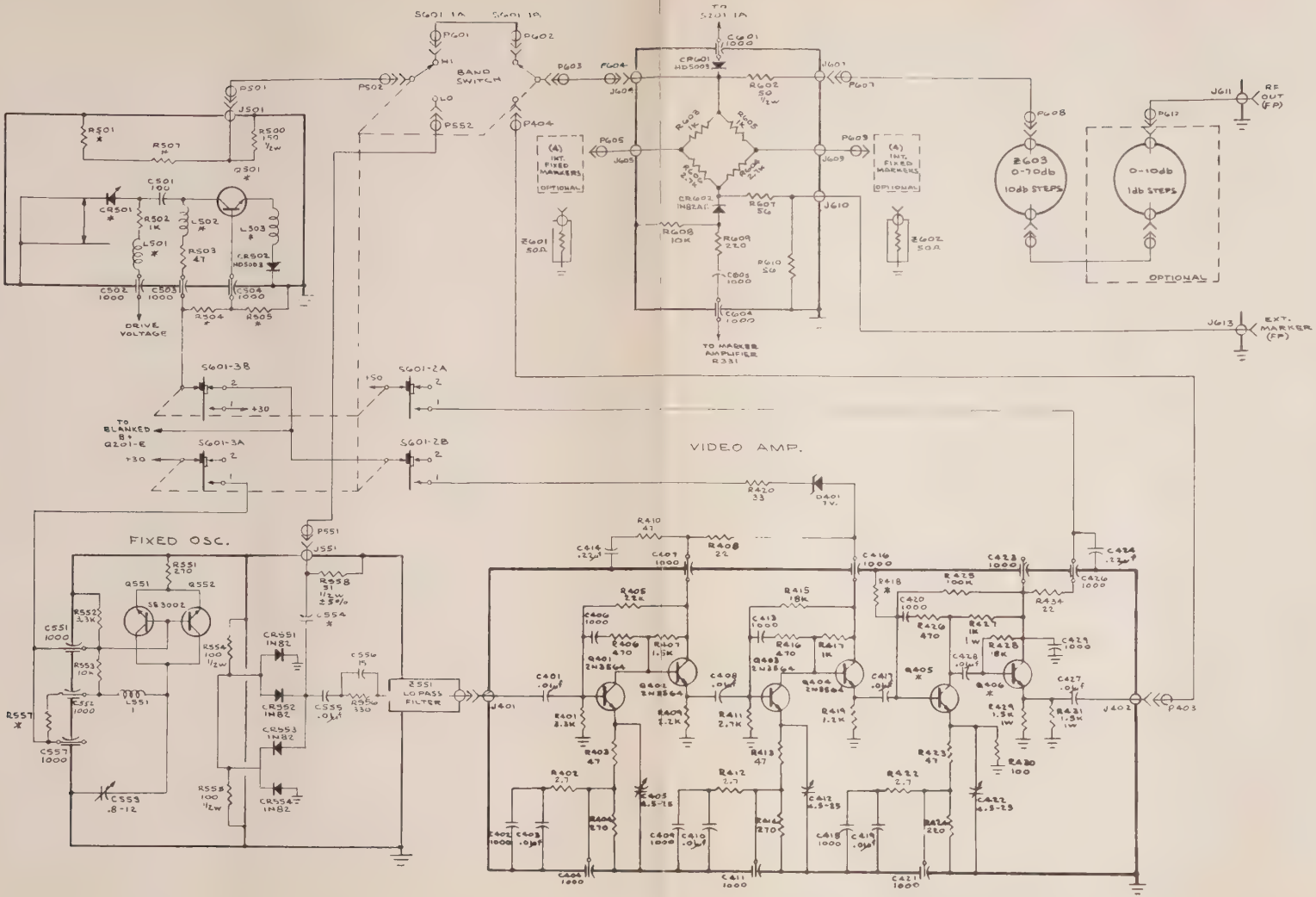


FIGURE 6-2
SWEEP OSCILLATOR, CW OSCILLATOR, MIXER, VIDEO AMPLIFIER

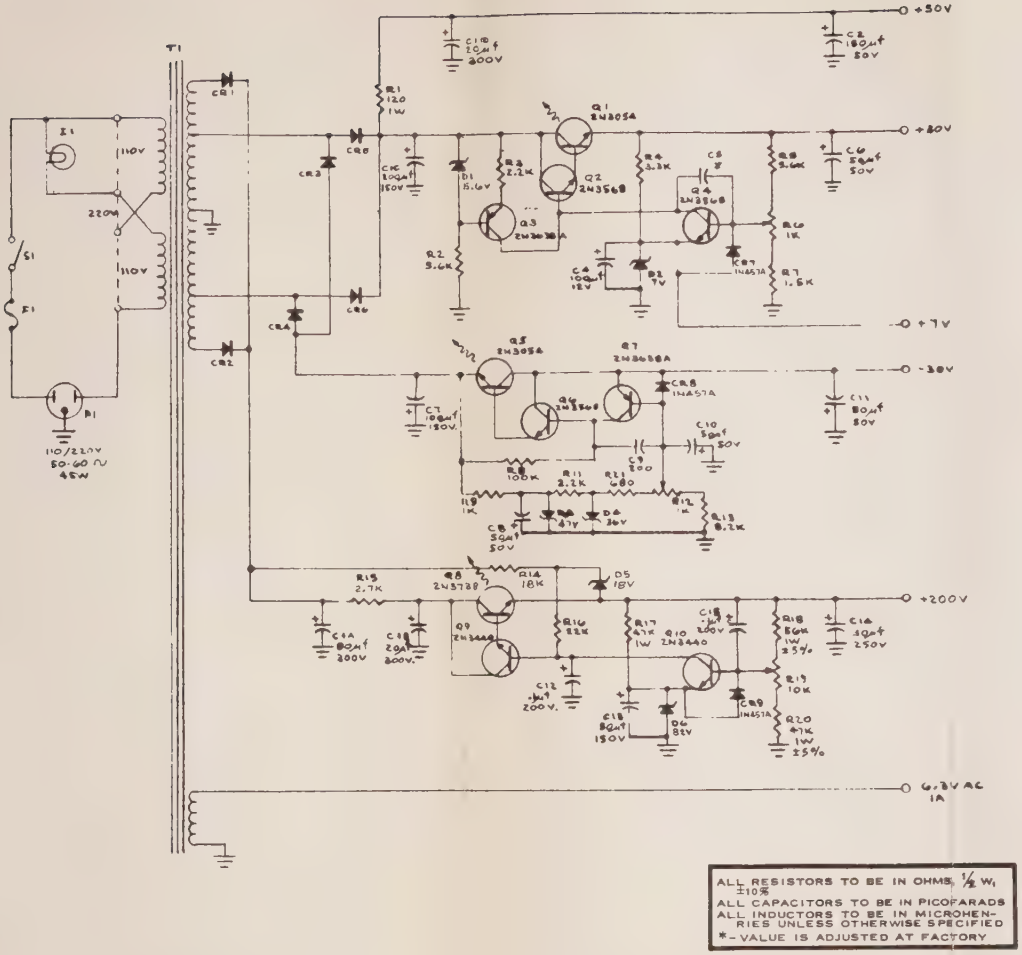


FIGURE 6-3
POWER SUPPLY
6-3

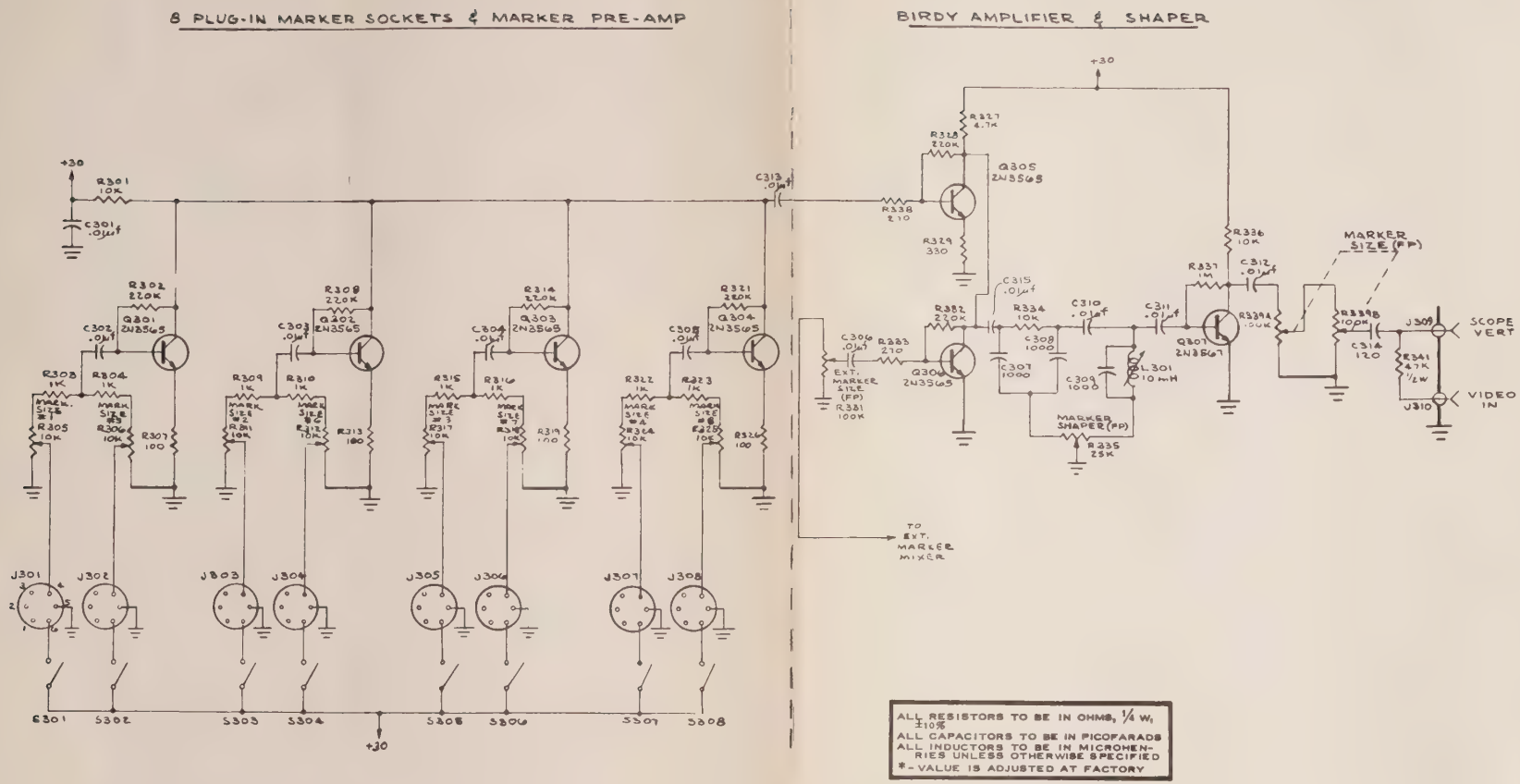


FIGURE 6-4
MARKER CIRCUITRY
6-4

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
C1A,C1B, C1C,C1D	012-075	Capacitor, Fixed, 80-20-20-200uf	Mallory 419.39A
C2	012-102	Capacitor, Fixed, 150uf, 50V	Cornell Dubilier 19Z148
C3		Not used	
C4	012-015	Capacitor, Fixed, 100uf, 12V	Sprague 30D107G012DC4
C5		Factory selected value	
C6	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C7	012-079	Capacitor, Fixed, 100uf, 150V	Mallory FP116A
C8	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C9	012-052	Capacitor, Fixed, 200pf	RMC Type C N1500
C10	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C11	012-082	Capacitor, Fixed, 50uf, 50V	Mallory PET 1980
C12	012-023	Capacitor, Fixed, 0.1uf, 200V	Standard Condenser MBA200
C13	012-061	Capacitor, Fixed, 50uf, 150V	Sprague TVA 1414
C14	012-014	Capacitor, Fixed, 30uf, 250V	Cornell Dubilier BR30-250
C15	012-023	Capacitor, Fixed, 0.1uf, 200V	Standard Condenser MBA200
C101	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C102	012-051	Capacitor, Fixed, 0.22uf	Cornell Dubilier 2S22
C103	012-016	Capacitor, Fixed, 100uf, 25V	Sprague 30D107G025DD2
C201		Factory selected value	
C202	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C203	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C204	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C301	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C302	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C303	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C304	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C305	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C306	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C307	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C308	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C309	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C310	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C311	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C312	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C313	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C314	012-013	Capacitor, Fixed, 120pf	RMC C120 N1500
C315	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
C401	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C402	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C403	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C404	012-037	Capacitor, Fixed, 1000pf	Allen Bradley SS5A-102W
C405	015-003	Capacitor, Variable, 4.5-25pf	Centralab 822CN
C406	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C407	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C408	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C409	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C410	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C411	012-037	Capacitor, Fixed, 1000pf	Allen Bradley SS5A-102W
C412	015-003	Capacitor, Variable, 4.5-25pf	Centralab 822CN
C413	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C414	012-051	Capacitor, Fixed, 0.22uf	Cornell Dubilier 2S22
C415		Not used	
C416	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C417	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C418	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C419	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C420	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C421	012-037	Capacitor, Fixed, 1000pf	Allen Bradley SS5A-102W
C422	015-003	Capacitor, Variable, 4.5-25pf	Centralab 822CN
C423	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C424	012-051	Capacitor, Fixed, 0.22uf	Cornell Dubilier 2S22
C425		Not used	
C426	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C427	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C428	012-050	Capacitor, Fixed, 0.01uf	RMC TA.01
C429	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C501	012-11[illegible]	Capacitor, Fixed, 100pf	JFD FCJ-81
C502	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C503	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C504	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C551	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C552	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
C553	015-004	Capacitor, Variable, 0.8-12pf	JFD VC-22GY
C554		Factory selected value	
C555	012-005	Capacitor, Fixed, 0.01uf	RMC Z5U.01
C556	012-103	Capacitor, Fixed, 15pf	RMC Type C NPO
C557	012-001	Capacitor, Fixed, 1000pf	Allen Bradley FA5C GMV
C601	012-002	Capacitor, Fixed, 1000pf	Allen Bradley FW5V102W
C602		Not used	
C603	012-009	Capacitor, Fixed, 1000pf	RMC SM.001
C604	012-002	Capacitor, Fixed, 1000pf	Allen Bradley FW5V102W
CR1	025-007	Diode, A13D2	General Electric A13D2
CR2	025-007	Diode, A13D2	General Electric A13D2
CR3	025-007	Diode, A13D2	General Electric A13D2
CR4	025-007	Diode, A13D2	General Electric A13D2
CR5	025-007	Diode, A13D2	General Electric A13D2
CR6	025-007	Diode, A13D2	General Electric A13D2
CR7	025-034	Diode, 1N457A	Sylvania 1N457A
CR8	025-034	Diode, 1N457A	Sylvania 1N457A
CR9	025-034	Diode, 1N457A	Sylvania 1N457A
CR101		Factory selected value	
CR102		Factory selected value	
CR103		Factory selected value	
CR104	025-034	Diode, 1N457A	Sylvania 1N457A
CR105	025-034	Diode, 1N457A	Sylvania 1N457A
CR106	025-034	Diode, 1N457A	Sylvania 1N457A
CR107	025-034	Diode, 1N457A	Sylvania 1N457A
CR108	025-034	Diode, 1N457A	Sylvania 1N457A
CR109	025-034	Diode, 1N457A	Sylvania 1N457A
CR110	025-034	Diode, 1N457A	Sylvania 1N457A
CR111	025-034	Diode, 1N457A	Sylvania 1N457A
CR112	025-034	Diode, 1N457A	Sylvania 1N457A
CR113	025-034	Diode, 1N457A	Sylvania 1N457A
CR114		Factory selected value	
CR201	025-034	Diode, 1N457A	Sylvania 1N457A
CR202	025-034	Diode, 1N457A	Sylvania 1N457A
CR203	025-034	Diode, 1N457A	Sylvania 1N457A
CR501		Factory selected value	

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
CR502	025-016	Diode, HD5003	Hughes HD5003
CR551	025-027	Diode, 1N82	Sylvania 1N82
CR552	025-027	Diode, 1N82	Sylvania 1N82
CR553	025-027	Diode, 1N82	Sylvania 1N82
CR554	025-027	Diode, 1N82	Sylvania 1N82
CR601	025-016	Diode, HD5003	Hughes HD5003
CR602	025-002	Diode, Miniature 1N82AG	Micro Optics 1N82AG
D1	025-018	Diode, Zener, 1N708, 5.6V	Texas Instrument 1N708
D2	025-033	Diode, VR-7A	Sarkes Tarzian VR-7A
D3	025-021	Diode, Zener, ZA47	Mallory ZA47
D4	025-022	Diode, Zener, ZA36	Mallory ZA36
D5	025-025	Diode, ZA18	Mallory ZA18
D6	025-019	Diode, Zener, ZA82	Mallory ZA82
D101	025-022	Diode, Zener, 36V	Mallory ZA36
D102	025-038	Diode, Zener, 15V	Mallory ZA15
D201	025-024	Diode, Zener, 28V	Sarkes Tarzian VR-28A
D401	025-033	Diode, VR-7A	Sarkes Tarzian VR-7A
F1	034-001	Fuse, 3AG, Lamp	Littelfuse 312001
I1	011-001	Bulb, Pilot Light	Drake 6063-634
J101	020-016	Connector, RF	Startronics 5069
J102	020-011	Connector, RF	Startronics UG625B/U
J201	020-016	Connector, RF	Startronics 5069
J301	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J302	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J303	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J304	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J305	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J306	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J307	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J308	054-003	Socket, 6-pin	Cinch Jones 201-41-06-243
J309	020-016	Connector, RF	Startronics 5069
J310	020-016	Connector, RF	Startronics 5069
J401	020-011	Connector, RF	Startronics UG625B/U
J402	020-011	Connector, RF	Startronics UG625B/U

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
J501	020-030	Connector, RF	Startronics UG185/U
J551	020-030	Connector, RF	Startronics UG185/U
J601		Not used	
J602		Not used	
J603		Not used	
J604	020-011	Connector, RF	Startronics UG625B/U
J605	020-018	Connector, RF	Startronics MX1684/U
J606		Not used	
J607	020-011	Connector, RF	Startronics UG625B/U
J608		Not used	
J609	020-018	Connector, RF	Startronics MX1684/U
J610	020-018	Connector, RF	Startronics MX1684/U
J611	020-017	Connector, RF	Startronics 5070
J612		Not used	
J613	020-017	Connector, RF	Startronics 5070
L301	035-008	Inductor, Fixed, 10mh	Central Coil H-0813-15
L501		Factory selected value	
L502		Factory selected value	
L503		Factory selected value	
L551	035-005	Inductor, Fixed, 1uh	Wilco 205-11
P1	019-004	Conductor, Line Cord	Alpha Wire 615
P403	020-021	Connector, RF	Startronics 88C/U
P404	020-021	Connector, RF	Startronics 88C/U
P501	020-021	Connector, RF	Startronics 88C/U
P502	020-021	Connector, RF	Startronics 88C/U
P551	020-021	Connector, RF	Startronics 88C/U
P552	020-021	Connector, RF	Startronics 88C/U
P601	020-021	Connector, RF	Startronics 88C/U
P602	020-021	Connector, RF	Startronics 88C/U
P603	020-021	Connector, RF	Startronics 88C/U
P604	020-021	Connector, RF	Startronics 88C/U
P605	020-021	Connector, RF	Startronics 88C/U
P606		Not used	
P607	020-021	Connector, RF	Startronics 88C/U
P608	020-021	Connector, RF	Startronics 88C/U
P609	020-021	Connector, RF	Startronics 88C/U

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
P610		Not used	
P611		Not used	
P612	020-021	Connector, RF	Startronics 88C/U
Q1	062-006	Transistor, 2N3054	RCA 2N3054
Q2	062-015	Transistor, 2N3568	Fairchild 2N3568
Q3	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q4	062-015	Transistor, 2N3568	Fairchild 2N3568
Q5	062-006	Transistor, 2N3054	RCA 2N3054
Q6	062-015	Transistor, 2N3568	Fairchild 2N3568
Q7	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q8	062-021	Transistor, 2N3738	Motorola 2N3738
Q9	062-008	Transistor, 2N3440	RCA 2N3440
Q10	062-008	Transistor, 2N3440	RCA 2N3440
Q101	062-002	Transistor, 2N3565	Fairchild 2N3565
Q102	062-002	Transistor, 2N3565	Fairchild 2N3565
Q103	062-002	Transistor, 2N3565	Fairchild 2N3565
Q104	062-015	Transistor, 2N3568	Fairchild 2N3568
Q105	062-015	Transistor, 2N3568	Fairchild 2N3568
Q106	062-008	Transistor, 2N3440	RCA 2N3440
Q107	062-008	Transistor, 2N3440	RCA 2N3440
Q108		Not used	
Q201	062-008	Transistor, 2N3440	RCA 2N3440
Q202	062-008	Transistor, 2N3440	RCA 2N3440
Q203	062-008	Transistor, 2N3440	RCA 2N3440
Q204	062-015	Transistor, 2N3568	Fairchild 2N3568
Q205		Not used	
Q206	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q207	062-010	Transistor, 2N3638A	Fairchild 2N3638A
Q301	062-002	Transistor, 2N3565	Fairchild 2N3565
Q302	062-002	Transistor, 2N3565	Fairchild 2N3565
Q303	062-002	Transistor, 2N3565	Fairchild 2N3565
Q304	062-002	Transistor, 2N3565	Fairchild 2N3565
Q305	062-002	Transistor, 2N3565	Fairchild 2N3565
Q306	062-002	Transistor, 2N3565	Fairchild 2N3565
Q307	062-003	Transistor, 2N3567	Fairchild 2N3567

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
Q401	062-001	Transistor, 2N3564	Fairchild 2N3564
Q402	062-001	Transistor, 2N3564	Fairchild 2N3564
Q403	062-001	Transistor, 2N3564	Fairchild 2N3564
Q404	062-001	Transistor, 2N3564	Fairchild 2N3564
Q405		Factory selected value	
Q406		Factory selected value	
Q501		Factory selected value	
Q551	062-013	Transistor, SE3002	Fairchild SE3002
Q552	062-013	Transistor, SE3002	Fairchild SE3002
R1	046-372	Resistor, Fixed, 120 ohm, 1W, ± 10%	Allen Bradley
R2	046-142	Resistor, Fixed, 5.6K ohm, ½W, ± 10%	Allen Bradley
R3	046-124	Resistor, Fixed, 2.2K ohm, ½W, ± 10%	Allen Bradley
R4	046-131	Resistor, Fixed, 3.3K ohm, ½W, ± 10%	Allen Bradley
R5	046-142	Resistor, Fixed, 5.6K ohm, ½W, ± 10%	Allen Bradley
R6	048-030	Resistor, Variable, 1K ohm	Texscan Corporation
R7	046-117	Resistor, Fixed, 1.5K ohm, ½W, ± 10%	Allen Bradley
R8	046-194	Resistor, Fixed, 100K ohm, ½W, ± 10%	Allen Bradley
R9	046-110	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R10		Not used	
R11	046-124	Resistor, Fixed, 2.2K ohm, ½W, ± 10%	Allen Bradley
R12	048-030	Resistor, Variable, 1K ohm	Texscan Corporation
R13	046-149	Resistor, Fixed, 8.2K ohm, ½W, ± 10%	Allen Bradley
R14	046-163	Resistor, Fixed, 18K ohm, ½W, ± 10%	Allen Bradley
R15	046-128	Resistor, Fixed, 2.7K ohm, ½W, ± 10%	Allen Bradley
R16	046-166	Resistor, Fixed, 22K ohm, ½W, ± 10%	Allen Bradley
R17	046-480	Resistor, Fixed, 47K ohm, 1W, ± 10%	Allen Bradley
R18	046-483	Resistor, Fixed, 56K ohm, 1W, ± 5%	Allen Bradley
R19	048-025	Resistor, Variable, 10K ohm	Texscan Corporation
R20	046-479	Resistor, Fixed, 47K ohm, 1W, ± 5%	Allen Bradley
R21	046-163	Resistor, Fixed, 680 ohm, ½W, ± 10%	Allen Bradley
R101	048-026	Resistor, Variable, 25K ohm	Texscan Corporation
R102	045-794	Resistor, Fixed, 100K ohm, ¼W, ± 10%	Allen Bradley
R103	045-794	Resistor, Fixed, 100K ohm, ¼W, ± 10%	Allen Bradley
R104	045-836	Resistor, Fixed, 1M ohm, ¼W, ± 10%	Allen Bradley
R105	045-780	Resistor, Fixed, 47K ohm, ¼W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R106	048-032	Resistor, Variable, 1M ohm	Texscan Corporation
R107	045-717	Resistor, Fixed, 1.5K ohm, ¼W, ± 10%	Allen Bradley
R108	048-023	Resistor, Variable, 2K ohm	Texscan Corporation
R109	045-717	Resistor, Fixed, 1.5K ohm, ¼W, ± 10%	Allen Bradley
R110	045-710	Resistor, Fixed, 1K ohm, ¼W, ± 10%	Allen Bradley
R111	045-752	Resistor, Fixed, 10K ohm, ¼W, ± 10%	Allen Bradley
R112	045-773	Resistor, Fixed, 33K ohm, ¼W, ± 10%	Allen Bradley
R113	045-787	Resistor, Fixed, 68K ohm, ¼W, ± 10%	Allen Bradley
R114	045-784	Resistor, Fixed, 56K ohm, ¼W, ± 10%	Allen Bradley
R115	045-766	Resistor, Fixed, 22K ohm, ¼W, ± 10%	Allen Bradley
R116	045-826	Resistor, Fixed, 560K ohm, ¼W, ± 10%	Allen Bradley
R117		Not used	
R118	045-752	Resistor, Fixed, 10K ohm, ¼W, ± 10%	Allen Bradley
R119	048-054	Resistor, Variable, 50K ohm	Texscan Corporation
R120A,R120B	048-048	Resistor, Variable, 500K/5K Switch	Texscan Corporation
S103			
R121	045-749	Resistor, Fixed, 8.2K ohm, ¼W, ± 10%	Allen Bradley
R122	045-714	Resistor, Fixed, 1.2K ohm, ¼W, ± 10%	Allen Bradley
R123	046-122	Resistor, Fixed, 2K ohm, ½W, ± 5%	Allen Bradley
R124		Not used	
R125	046-208	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R126		Not used	
R127	046-093	Resistor, Fixed, 390 ohm, ½W, ± 10%	Allen Bradley
R128	046-135	Resistor, Fixed, 3.9K ohm, ½W, ± 10%	Allen Bradley
R129	046-138	Resistor, Fixed, 4.7K ohm, ½W, ± 10%	Allen Bradley
R130	046-159	Resistor, Fixed, 15K ohm, ½W, ± 10%	Allen Bradley
R131	048-023	Resistor, Variable, 2K ohm	Texscan Corporation
R132	046-134	Resistor, Fixed, 2.7K ohm, ½W, ± 10%	Allen Bradley
R133	046-110	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R134	046-114	Resistor, Fixed, 1.2K ohm, ½W, ± 10%	Allen Bradley
R135	046-787	Resistor, Fixed, 68K ohm, 2W, ± 10%	Allen Bradley
R136	046-509	Resistor, Fixed, 220K ohm, 1W, ± 10%	Allen Bradley
R137	045-826	Resistor, Fixed, 560K ohm, ¼W, ± 10%	Allen Bradley
R138	045-826	Resistor, Fixed, 560K ohm, ¼W, ± 10%	Allen Bradley
R139	045-826	Resistor, Fixed, 560K ohm, ¼W, ± 10%	Allen Bradley
R140	045-826	Resistor, Fixed, 560K ohm, ¼W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R141	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R142	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R143	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R144	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R145	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R146	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R147		Factory selected value	
R148	045-766	Resistor, Fixed, 22K ohm, ½W, ± 10%	Allen Bradley
R149	045-770	Resistor, Fixed, 27K ohm, ½W, ± 10%	Allen Bradley
R150	045-773	Resistor, Fixed, 33K ohm, ½W, ± 10%	Allen Bradley
R151	045-780	Resistor, Fixed, 47K ohm, ½W, ± 10%	Allen Bradley
R152	045-784	Resistor, Fixed, 56K ohm, ½W, ± 10%	Allen Bradley
R153	045-791	Resistor, Fixed, 82K ohm, ½W, ± 10%	Allen Bradley
R154	045-798	Resistor, Fixed, 120K ohm, ½W, ± 10%	Allen Bradley
R155	045-805	Resistor, Fixed, 180K ohm, ½W, ± 10%	Allen Bradley
R156	045-815	Resistor, Fixed, 330K ohm, ½W, ± 10%	Allen Bradley
R157	045-826	Resistor, Fixed, 560K ohm, ½W, ± 10%	Allen Bradley
R158		Factory selected value	
R159	048-024	Resistor, Variable, 5K ohm	Texscan Corporation
R160		Not used	
R161	048-030	Resistor, Variable, 1K ohm	Texscan Corporation
R162	045-738	Resistor, Fixed, 4.7K ohm, ½W, ± 10%	Allen Bradley
R163	048-029	Resistor, Variable, 250K ohm	Texscan Corporation
R164A,R164B	048-078	Resistor, Variable, 500K/250K Switch	Texscan Corporation
S101			
R165		Not used	
R166	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R167	048-030	Resistor, Variable, 1K ohm	Texscan Corporation
R168	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R169	045-773	Resistor, Fixed, 33K ohm, ½W, ± 10%	Allen Bradley
R170		Factory selected value	
R201	045-641	Resistor, Fixed, 33 ohm, ½W, ± 10%	Allen Bradley
R202		Factory selected value	
R203	045-791	Resistor, Fixed, 82K ohm, ½W, ± 10%	Allen Bradley
R204	045-703	Resistor, Fixed, 680 ohm, ½W, ± 10%	Allen Bradley
R205	045-766	Resistor, Fixed, 22K ohm, ½W, ± 10%	Allen Bradley
R206	045-749	Resistor, Fixed, 8.2K ohm, ½W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R207	045-749	Resistor, Fixed, 8.2K ohm, ½W, ± 10%	Allen Bradley
R208,S201	048-059	Resistor, Variable, 10K/4P2T Switch	Texscan Corporation
R209	048-034	Resistor, Variable, 250 ohm	Texscan Corporation
R210	048-036	Resistor, Variable, 5K ohm	Texscan Corporation
R211	045-766	Resistor, Fixed, 22K ohm, ½W, ± 10%	Allen Bradley
R212	045-749	Resistor, Fixed, 8.2K ohm, ½W, ± 10%	Allen Bradley
R213	045-665	Resistor, Fixed, 82 ohm, ½W, ± 10%	Allen Bradley
R301	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R302	045-808	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R303	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R304	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R305	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R306	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R307	045-668	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R308	045-808	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R309	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R310	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R311	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R312	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R313	045-668	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R314	045-808	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R315	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R316	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R317	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R318	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R319	045-668	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R320		Not used	
R321	045-808	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R322	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R323	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R324	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R325	048-014	Resistor, Variable, 10K ohm	Texscan Corporation
R326	045-668	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R327	045-738	Resistor, Fixed, 4.7K ohm, ½W, ± 10%	Allen Bradley
R328	045-808	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R329	045-689	Resistor, Fixed, 330 ohm, ½W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R330		Not used	
R331	048-051	Resistor, Variable, 100K ohm	Texscan Corporation
R332	045-808	Resistor, Fixed, 220K ohm, ½W, ± 10%	Allen Bradley
R333	045-686	Resistor, Fixed, 270 ohm, ½W, ± 10%	Allen Bradley
R334	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R335,R339A	048-060	Resistor, Variable, 100K/100K/25K	Texscan Corporation
R339B			
R336	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R337	045-836	Resistor, Fixed, 1M ohm, ½W, ± 10%	Allen Bradley
R338	045-686	Resistor, Fixed, 270 ohm, ½W, ± 10%	Allen Bradley
R340		Not used	
R341	046-180	Resistor, Fixed, 47K ohm, ½W, ± 10%	Allen Bradley
R401	045-731	Resistor, Fixed, 3.3K ohm, ½W, ± 10%	Allen Bradley
R402	045-602	Resistor, Fixed, 2.7 ohm, ½W, ± 10%	Allen Bradley
R403	045-654	Resistor, Fixed, 47 ohm, ½W, ± 10%	Allen Bradley
R404	045-686	Resistor, Fixed, 270 ohm, ½W, ± 10%	Allen Bradley
R405	045-766	Resistor, Fixed, 22K ohm, ½W, ± 10%	Allen Bradley
R406	045-696	Resistor, Fixed, 470 ohm, ½W, ± 10%	Allen Bradley
R407	045-717	Resistor, Fixed, 1.5K ohm, ½W, ± 10%	Allen Bradley
R408	045-640	Resistor, Fixed, 22 ohm, ½W, ± 10%	Allen Bradley
R409	045-724	Resistor, Fixed, 2.2K ohm, ½W, ± 10%	Allen Bradley
R410	045-654	Resistor, Fixed, 47 ohm, ½W, ± 10%	Allen Bradley
R411	045-728	Resistor, Fixed, 2.7K ohm, ½W, ± 10%	Allen Bradley
R412	045-602	Resistor, Fixed, 2.7 ohm, ½W, ± 10%	Allen Bradley
R413	045-654	Resistor, Fixed, 47 ohm, ½W, ± 10%	Allen Bradley
R414	045-686	Resistor, Fixed, 270 ohm, ½W, ± 10%	Allen Bradley
R415	045-763	Resistor, Fixed, 18K ohm, ½W, ± 10%	Allen Bradley
R416	045-696	Resistor, Fixed, 470 ohm, ½W, ± 10%	Allen Bradley
R417	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R418		Factory selected value	
R419	045-[illegible]14	Resistor, Fixed, 1.2K ohm, ½W, ± 10%	Allen Bradley
R420	[illegible]	Resistor, Fixed, 33 ohm, ½W, ± 10%	Allen Bradley
R421		Not used	
R422	045-602	Resistor, Fixed, 2.7 ohm, ½W, ± 10%	Allen Bradley
R423	045-654	Resistor, Fixed, 47 ohm, ½W, ± 10%	Allen Bradley
R424	045-682	Resistor, Fixed, 220 ohm, ½W, ± 10%	Allen Bradley
R425	045-794	Resistor, Fixed, 100K ohm, ½W, ± 10%	Allen Bradley

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
R426	045-696	Resistor, Fixed, 470 ohm, ½W, ± 10%	Allen Bradley
R427	046-410	Resistor, Fixed, 1K ohm, 1W, ± 10%	Allen Bradley
R428	045-763	Resistor, Fixed, 18K ohm, ½W, ± 10%	Allen Bradley
R429	046-417	Resistor, Fixed, 1.5K ohm, 1W, ± 10%	Allen Bradley
R430	045-668	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R431	046-417	Resistor, Fixed, 1.5K ohm, 1W, ± 10%	Allen Bradley
R432		Not used	
R433		Not used	
R434	045-640	Resistor, Fixed, 22 ohm, ½W, ± 10%	Allen Bradley
R500	046-075	Resistor, Fixed, 150 ohm, ½W, ± 10%	Allen Bradley
R501		Factory selected value	
R502	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R503	045-654	Resistor, Fixed, 47 ohm, ½W, ± 10%	Allen Bradley
R504		Factory selected value	
R505		Factory selected value	
R506		Not used	
R507		Factory selected value	
R551	045-686	Resistor, Fixed, 270 ohm, ½W, ± 10%	Allen Bradley
R552	045-731	Resistor, Fixed, 3.3K ohm, ½W, ± 10%	Allen Bradley
R553	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R554	046-068	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R555	046-068	Resistor, Fixed, 100 ohm, ½W, ± 10%	Allen Bradley
R556	045-689	Resistor, Fixed, 330 ohm, ½W, ± 10%	Allen Bradley
R557		Factory selected value	
R558	046-056	Resistor, Fixed, 51 ohm, ½W, ± 5%	Allen Bradley
R601		Not used	
R602	047-083	Resistor, Precision, 50 ohm, ½W, ± 10%	Texscan Corporation
R603	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R604	045-728	Resistor, Fixed, 2.7K ohm, ½W, ± 10%	Allen Bradley
R605	045-710	Resistor, Fixed, 1K ohm, ½W, ± 10%	Allen Bradley
R606	045-728	Resistor, Fixed, 2.7K ohm, ½W, ± 10%	Allen Bradley
R607	045-658	Resistor, Fixed, 56 ohm, ½W, ± 10%	Allen Bradley
R608	045-752	Resistor, Fixed, 10K ohm, ½W, ± 10%	Allen Bradley
R609	045-682	Resistor, Fixed, 220 ohm, ½W, ± 10%	Allen Bradley
R610	045-658	Resistor, Fixed, 56 ohm, ½W, ± 10%	Allen Bradley
S1	057-004	Switch, Toggle	Cutler Hammer 8280K16

CIRCUIT REF. NO.	TEXSCAN STOCK NO.	DESCRIPTION	MFG., MFG. PART NO.
S301	057-002	Switch, Rocker	Stackpole RS-50-FB
S302	057-002	Switch, Rocker	Stackpole RS-50-FB
S303	057-002	Switch, Rocker	Stackpole RS-50-FB
S304	057-002	Switch, Rocker	Stackpole RS-50-FB
S305	057-002	Switch, Rocker	Stackpole RS-50-FB
S306	057-002	Switch, Rocker	Stackpole RS-50-FB
S307	057-002	Switch, Rocker	Stackpole RS-50-FB
S308	057-002	Switch, Rocker	Stackpole RS-50-FB
S601	C200-030-02	Switch	Texscan Corporation
T1	B061-009	Transformer, Power	American Magnetics 3531
Z551	A204-059	Filter	Texscan Corporation
Z601	A200-005-01	Termination	Texscan Corporation
Z602	A200-005-01	Termination	Texscan Corporation
Z603	C200-018	Attenuator	Texscan Corporation

WARRANTY

All our products are warranted against defective materials and workmanship for one year from date of shipment. Texscan will repair or replace products (except tubes and transistors) which are found to be defective during the one-year warranty period. This warranty does not apply to consequential damage.

CLAIM FOR DAMAGE IN SHIPMENT

Your instrument should be inspected and tested as soon as it is received. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier, or if insured separately, with the insurance company.

CHANGE IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold.

SHIPPING

On receipt of shipping authorization from the factory, forward the instrument prepaid. Care should be taken in packing the instrument and identifying it by model number and serial number.

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